

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

First Named		
Inventor :	William R. Priedeman, Jr.	
Appln. No.:	10/511,784	Confirmation No.: 4209
Filed :	October 15, 2004	Group Art Unit: 1791
For :	Smoothing Method For Layered Deposition Modeling	Examiner: John L. Goff II
Docket No.:	S697.12-0065	

REPLY BRIEF FOR APPELLANTS

FILED ELECTRONICALLY ON DECEMBER 22, 2010

This is in response to the Examiner's Answer dated October 25, 2010, in which claims 1, 3-5, 8, 10, 11, 18, 20-23, 27, 28, 33, 43, and 45-49 stand rejected.

REAL PARTY IN INTEREST

The following statement of the real party in interest is identical to the statement presented in Appellants' Appeal Brief of August 3, 2010. Stratasys, Inc., a corporation organized under the laws of the state of Delaware, and having offices at 7665 Commerce Way, Eden Prairie, MN 55344, has acquired the entire right, title and interest in and to the invention, the application, and any and all patents to be obtained therefor.

RELATED APPEALS AND INTERFERENCES

There are no related appeals that may directly affect or be directly affect by or have a bearing on the Board's decision in this appeal.

STATUS OF THE CLAIMS

The following status of the claims is identical to the status presented in Appellants' Appeal Brief.

- I. Total number of claims in the application
- | | |
|--------------------------------|------|
| Claims in the application are: | 1-49 |
|--------------------------------|------|
- II. Status of all the claims
- | | |
|---------------------------------------|---|
| A. Claims canceled: | 2, 6, 7, 9, 12-17, 24-26, 34-42, and 44 |
| B. Claims withdrawn but not canceled: | none |
| C. Claims pending: | 1, 3-5, 8, 10, 11, 18, 20-23, 27, 28, 33, 43, and 45-49 |
| D. Claims allowed: | none |
| E. Claims rejected: | 1, 3-5, 8, 10, 11, 18, 20-23, 27, 28, 33, 43, and 45-49 |
| F. Claims objected to: | none |
- III. Claims on appeal
- | | |
|---------------------------|---|
| The claims on appeal are: | 1, 3-5, 8, 10, 11, 18, 20-23, 27, 28, 33, 43, and 45-49 |
|---------------------------|---|

STATUS OF AMENDMENTS

The following status of amendments is identical to the status presented in Appellants' Appeal Brief.

Applicants filed an Amendment After Final on May 3, 2010, in which claims 1, 21, and 43 were amended, and claims 16, 19, and 44 were canceled. The Examiner then submitted an Advisory Action on May 24, 2010, which stated that, for purposes of appeal, the amendments will be entered. The Advisory Action also maintained the rejections of pending claims 1, 3-5, 8, 10, 11, 18, 20-23, 27, 28, 33, 43, and 45-49.

SUMMARY OF CLAIMED SUBJECT MATTER

The following summary is identical to the summary presented in Appellants' Appeal Brief.

The present invention, as set forth in independent claim 1, is a method for making a three-dimensional object (10). The method includes providing an object (10) built from a polymeric or wax modeling material using a fused deposition modeling technique (present application, page 4, lines 27-29; and page 5, lines 24-30). The built object has an object surface (12, 14, 16, 18) formed of the modeling material (present application, page 5, line 32 to page 6, line 2). The object surface (12, 14, 16, 18) has at least one surface effect due to the fused deposition modeling technique, where the at least one surface effect extends substantially across an entirety of the object surface (12, 14, 16, 18) (present application, FIG. 1; page 2, lines 16-30; page 5, line 24 to page 6, line 2; and page 6, lines 17-20). The at least one surface effect is selected from the group consisting of a stair step effect (present application, FIG. 1; page 2, lines 18-22; and page 6, lines 17-18), striation (present application, FIG. 1; page 2, lines 16-18; and page 6, line 20), a roughness due to errors in building the object (10) (present application, FIG. 1; page 2, lines 23-30; and page 6, line 20), and a combination thereof.

The object (10) exhibits porosity due to the fused deposition modeling technique (present application, page 6, lines 23-26 as amended in Applicant's Amendment of November 18, 2009, which was accepted by the Examiner in the Final Office Action of February 3, 2010). The method also includes exposing the object (10) to vapors of a solvent that transiently softens the modeling material at the object surface (12, 14, 16, 18) (present application, FIG. 2, page 8, lines 10-16). The method further includes reflowing the softened modeling material to substantially eliminate the at least one surface effect and to substantially eliminate the porosity of the object (10) at the object surface (12, 14, 16, 18) (present application, FIG. 2, page 8, lines 10-16; and page 8, lines 18-24 as amended in Applicant's Amendment of November 18, 2009, which was accepted by the Examiner in the Final Office Action of February 3, 2010).

The present invention, as set forth in independent claim 21, is a method for making a three-dimensional object (10), where the method includes providing an object (10) built from a plurality of layers with a modeling material using a fused deposition modeling technique (present application, page 4, lines 27-29; and page 5, lines 24-30). The object (10) has an object surface

(12, 14, 16, 18), where the plurality of layers create at least one surface effect extending substantially across an entirety of the object surface (12, 14, 16, 18) (present application, FIG. 1; page 2, lines 16-30; page 5, line 24 to page 6, line 2; and page 6, lines 17-20). The at least one surface effect being selected from the group consisting of a stair step effect (present application, FIG. 1; page 2, lines 18-22; and page 6, lines 17-18), striation (present application, FIG. 1; page 2, lines 16-18; and page 6, line 20), a roughness due to errors in building the object (10) (present application, FIG. 1; page 2, lines 23-30; and page 6, line 20), and a combination thereof.

The object (10) exhibits porosity due to the fused deposition modeling technique (present application, page 6, lines 23-26 as amended in Applicant's Amendment of November 18, 2009, which was accepted by the Examiner in the Final Office Action of February 3, 2010). The method also includes exposing the object (10) to vapors of a solvent that transiently softens the modeling material at the object surface (12, 14, 16, 18) (present application, FIG. 2, page 8, lines 10-16). The method further includes reflowing the softened modeling material to substantially eliminate the at least one surface effect substantially across the entirety of the object surface 12, 14, 16, 18) and to substantially eliminate the porosity of the object at the object surface 12, 14, 16, 18) (present application, FIG. 2, page 8, lines 10-16; and page 8, lines 18-24 as amended in Applicant's Amendment of November 18, 2009, which was accepted by the Examiner in the Final Office Action of February 3, 2010).

The present invention, as set forth in independent claim 43, is a method for treating a three-dimensional object (10) built with a modeling material using a fused deposition modeling technique (present application, page 4, lines 27-29; and page 5, lines 24-30). The method includes providing the three-dimensional object (10) to a vessel (30) configured to contain vapors of a solvent (present application, page 6, line 27 to page 7, line 4). Substantially an entire exterior surface (12, 14, 16, 18) of the three-dimensional object (10) comprises at least one surface effect caused by the fused deposition modeling technique (present application, FIG. 1; page 2, lines 16-30; page 5, line 24 to page 6, line 2; and page 6, lines 17-20). The at least one surface effect is selected from the group consisting of a stair-step effect created by layering of a plurality of layers of the modeling material (present application, FIG. 1; page 2, lines 18-22; and page 6, lines 17-18), striation created by formation of roads of the modeling material (present application, FIG. 1; page 2, lines 16-18; and page 6, line 20), surface roughness created by errors

in the building of the three-dimensional object (10) (present application, FIG. 1; page 2, lines 23-30; and page 6, line 20), and a combination thereof.

The object (10) exhibits porosity due to the fused deposition modeling technique (present application, page 6, lines 23-26 as amended in Applicant's Amendment of November 18, 2009, which was accepted by the Examiner in the Final Office Action of February 3, 2010). The method also includes placing the three-dimensional object (10) in the vessel (30) in a manner that exposes substantially the entire exterior surface (12, 14, 16, 18) of the three-dimensional object (10) to the vapors of the solvent, where the vapors of the solvent transiently soften the modeling material across the entire exposed exterior surface (12, 14, 16, 18) of the three-dimensional object (10) (present application, FIG. 2, page 8, lines 10-16; page 6, line 27 to page 7, line 4). The method further includes reflowing the softened modeling material to substantially eliminate the at least one surface effect across the entire exposed exterior surface (12, 14, 16, 18) and to substantially eliminate the porosity of the object (10) at the object surface (12, 14, 16, 18) (present application, FIG. 2, page 8, lines 10-16; and page 8, lines 18-24 as amended in Applicant's Amendment of November 18, 2009, which was accepted by the Examiner in the Final Office Action of February 3, 2010).

GROUND OF REJECTION TO BE REVIEWED ON APPEAL

The following grounds of rejection are identical to those presented in Appellants' Appeal Brief.

Claims 1-3, 8, 10, 11, 18, 21, 22, 27, 28, 33, 43, 45, and 47-49 stand rejected as being obvious over the specification of the present application (pages 1-4 and 8) as exemplified in part by Crump, U.S. Patent No. 5,121,329 ("Crump") in view of Joseph et al., U.S. Patent No. 3,807,054 ("Joseph") or Edmonds, U.S. Patent No. 5,448,838 ("Edmonds"), and optionally, Batchelder, U.S. Patent No. 5,652,925 ("Batchelder").

Claims 4, 5, 23, and 46 stand rejected as being obvious over the specification of the present application as exemplified in part by Crump in view of Joseph/Edmonds and optionally Batchelder, and further in view of Dahlin et al., U.S. Patent No. 6,022,207 ("Dahlin").

Claim 20 stands rejected as being obvious over the specification of the present application as exemplified in part by Crump in view of Joseph/Edmonds and optionally Batchelder, and further in view of Leyden et al., U.S. Patent No. 5,143,663 ("Leyden").

Claims 18 and 48 stand rejected as being obvious over the specification of the present application as exemplified in part by Crump in view of Joseph/Edmonds and optionally Batchelder, and further in view of Gessner, U.S. Patent No. 4,983,223 (“Gessner”).

ARGUMENT

Appellants reassert the arguments presented in the Appeal Brief filed on August 3, 2010. The following points address the Examiner's responses to Appellants' Arguments, as presented in the Examiner's Answer on pages 10-16. Appellants wish to thank the Examiner for further clarifying his points of contention on appeal.

I. The Examiner Has Not Established a Prima Facie Conclusion of Obviousness

The Examiner bears the initial burden of factually supporting any prima facie conclusion of obviousness with a rationale that all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination yielded nothing more than predictable results to one of ordinary skill in the art. *KSR International Co. v. Teleflex Inc.*, 550 U.S. 398, 82 USPQ2d 1385, 1395 (2007). Furthermore, the mere fact that references can be combined or modified does not render the resultant combination obvious unless the results would have been predictable to one of ordinary skill in the art. *KSR*, 550 U.S. 398, 82 USPQ2d at 1396.

Appellants respectfully assert that the Examiner has only provided factual support for the contention that Joseph and Edmonds could be combined with Crump, but has not provided factual support that the combination yields only predictable results. For example, the Examiner's Answer stated that Joseph and Edmonds do not limit the types of objects that could be vapor smoothed, implying that there is a motivation to combine the references because Joseph and Edmonds do not expressly prevent the combination.

In particular, the Examiner stated that the solvent smoothing technique in Joseph and Edmonds is not described in any way as effective or dependent on how the object is formed (Examiner's Answer, page 10); that there is not suggestion in Joseph that the cracks, scratches and voids eliminated and smoothed are limited to any particular size (Examiner's Answer, page 11); that the direction provided by Joseph and Edmonds is that solvent vapors are suitable for smoothing objects built from plastic without limitation as to any particular technique used to

form the object (Examiner's Answer, page 13); and that neither reference suggest using solvent smoothing to eliminate any defects on the surface of the plastic objects is in any way dependent upon the technique used to form the plastic objects (Examiner's Answer, page 16).

The mere fact that Joseph and Edmonds could be combined with Crump, such as based on the teachings in the present application, does not provide factual support for combining these references to attain the combinations recited in the pending claims on appeal. Furthermore, as discussed below, the combination of the vapor smoothing process with three-dimensional objects built using the fused deposition modeling technique provide unpredictable and unexpected results.

A. Unpredictable and Unexpected Results of Substantial Elimination of Surface Effects

As discussed in Appellants' Appeal Brief, independent claims 1, 21, and 43 are each directed to a method that recites providing a three-dimensional object built using a fused deposition modeling technique. As illustrated in FIG. 1 of the present application (reproduced below), three-dimensional objects built using the fused deposition modeling technique exhibit one or more surface effects due to the fused deposition modeling technique, where the surface effect(s) may extend substantially across an entirety of the object surface (claim 43 recites an "exterior surface") (present application, FIG. 1; page 2, lines 16-30; page 5, line 24 to page 6, line 2; and page 6, lines 17-20).

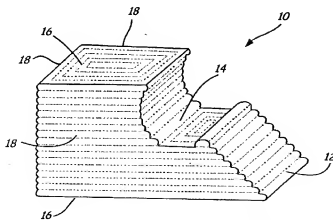


FIG. 1

For example, the object surface may exhibit stair-step effects created by the formation of successive layers, such as shown across angled surface 12 and curved surface 14 (present application, FIG. 1; page 2, lines 18-22; and page 6, lines 17-18). Additionally, the object surface may exhibit striation (e.g., texturing) created by formation of roads of the modeling material, such as shown across horizontal surfaces 16 and vertical surfaces 18 (present application, FIG. 1; page 2, lines 16-18; and page 6, line 20). Furthermore, the object surface may also exhibit roughness in one or more locations due to errors in building the three-dimensional object with the fused deposition modeling technique (present application, FIG. 1; page 2, lines 23-30; and page 6, line 20).

Pursuant to the method of claims 1, 21, and 43, the three-dimensional object may be exposed to vapors of a solvent that transiently soften the modeling material at the object surface, and the softened modeling material may reflow to substantially eliminate the surface effect(s) to provides a smooth surface (present application, FIG. 2, page 8, lines 10-16).

This substantial elimination of surface effects due to the fused deposition modeling technique, which extends substantially across an entirety of the object surface, is an unpredictable and unexpected result to one of ordinary skill in the art. Joseph and Edmonds are each directed to the use of vaporized solvents on articles (e.g., telephone casings) to remove scratches, dents, blemishes, small voids, and the like (e.g., for refurbishing such articles) (see e.g., Joseph, col. 4, lines 42-48; and Edmonds, col. 2, lines 43-51 and col. 3, lines 1-8). Despite the Examiner's contention that "there is no suggestion that the cracks, scratches, and voids eliminated and smoothed are limited to any particular size" (Examiner's Answer, page 11), neither Joseph nor Edmonds disclose any cracks, scratches, or voids that collectively extend or otherwise cover substantially the entire object surface.

Indeed, prior to the current invention, it was unclear to Appellants whether a vapor smoothing process would be effective to substantially eliminate the surface effects (due to the fused deposition modeling technique) that extend substantially across the entire object surface. Indeed, Appellants assert that this is one reason why those skilled in the art have previously resorted to smoothing techniques such as manual trimming, machining or grinding, buffing with cloths, sand paper, or solution-born abrasives, and the like to smooth the surfaces of three-dimensional objects built using layered manufacturing rapid prototyping techniques, such as the fused deposition modeling technique (present application, page 3, lines 6-17).

Additionally, as discussed in Appellants' Appeal Brief, solvent vapors are not suitable for smoothing objects built from all forms of layered manufacturing rapid prototyping techniques. For example, objects built with layered manufacturing rapid prototyping techniques such as the stereolithographic processes of Leyden use solvent vapors to remove excess resins (Leyden, col. 6, lines 56-68; col. 9, lines 34-39; and col. 11, lines 35-44). These processes require subsequent smoothing processes, such as applying and curing an additional amount of the curable resin to fill in the surface discontinuities, to provide smooth surfaces (Leyden, col. 7, lines 1-15).

The Examiner's Answer stated that "it is unclear how the use of an absorbent pad and solvent to drain excess liquid resin from an object formed in a stereolithographic process prior to setting the surface of the object evidences solvent vapors are not suitable for smoothing objects built from all forms of layered manufacturing rapid prototyping techniques." Appellants believe the following explanation with clarify that solvents or solvent vapors are not suitable for smoothing the surfaces of objects built using the stereolithographic process of Leyden.

As well understood by those of ordinary skill in the art, the stereolithographic process involves curing successive layers of a cross-linkable resin (e.g., a photocurable material) to form a three-dimensional object. Upon cross-linking, the resin material is effectively insoluble in a solvent (e.g., in methylene chloride). It is understood that over an extended and prolonged period of time, portions of the cross-linked material may eventually dissolve in the solvent (e.g., due to chemical breakdowns), but this duration would effectively eliminate any benefits attained with a vapor smoothing process, and could potentially degrade the geometry of the three-dimensional object.

This is why, for example, Leyden discloses applying additional coatings of resin, and curing the additional resin, to smooth the part. The absorbent pad and solvent disclosed in Leyden is used to clean any un-cured resin from the surface of the part, since the un-cured resin may still be soluble in the solvent. As mentioned above, Leyden also discloses the use of solvent vapors to remove excess un-cured resins. However, the solvents and solvent vapors are not used to soften and reflow the cross-linked material of the three-dimensional object. This unsuitability of the vapor smoothing process for stereolithographic objects further illustrates the unexpected results obtained with the presently claimed invention.

B. Unpredictable and Unexpected Results of Substantial Elimination of Surface Porosity

In addition, claims 1, 21, and 43 each also recite that the object exhibits porosity due to the fused deposition modeling technique, and that the steps of exposing the object to vapors of a solvent and reflowing the softened modeling material also substantially eliminate the porosity of the object at the object surface. As stated in the Declaration of Robert L. Zinniel (“Zinniel Declaration”) and in the Declaration of Francisco Medina (“Medina Declaration”), the porous regions are inherent in 3D object built with the fused deposition modeling technique due to the build technique (see e.g., Zinniel Decl. ¶ 10). The pores are created to provide a cushion in the build parameters when depositing the modeling material to maintain the dimensional accuracy of the 3D object, as discussed in Batchelder (U.S. Patent No. 5,653,925) (Zinniel Decl. ¶ 10).

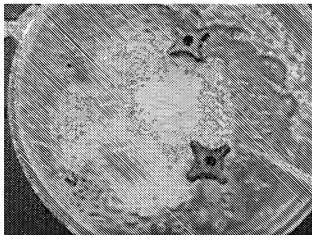


Image 5

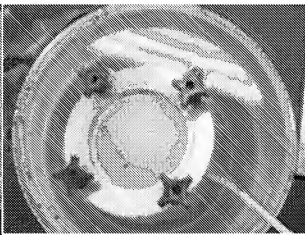


Image 6

The claimed method of exposing the object to solvent vapors that transiently soften the modeling material at the object surface and reflowing the softened modeling material also substantially eliminates the porosity of the three-dimensional object at the object surface (Zinniel Decl. ¶ 2, and Medina Decl. ¶ 2). This is illustrated by comparing Images 5 and 6 of the Zinniel Declaration (reproduced above), where Image 5 shows a three-dimensional object built using the fused deposition modeling technique prior to the claimed smoothing method, and Image 6 shows the 3D object after being subjected to the claimed smoothing method (Zinniel Decl., ¶¶ 9-11).

In comparison, when an identical three-dimensional object built using the fused deposition modeling technique was subjected to hand sanding to smooth the surface of the three-

dimensional object, the porosity was not substantially eliminated at the object surface (Zinniel Decl., ¶ 12). This is illustrated in Image 7 of the Zinniel Declaration (reproduced below).

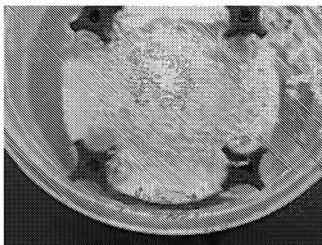


Image 7

Thus, the substantial elimination of the porosity at the object surface attained by the claimed method potentially seals the exposed area, which may create water-tight three-dimensional objects that can withstand pressure buildup (Zinniel Decl. ¶ 11, and Medina Decl. ¶ 2).

This substantial elimination of the surface porosity, which also extends substantially across an entirety of the object surface, is also an unpredictable and unexpected result to one of ordinary skill in the art. As mentioned above, Joseph and Edmonds each directed to the use of vaporized solvents on articles (e.g., telephone casings) to remove scratches, dents, blemishes, small voids, and the like (e.g., for refurbishing such articles) (see e.g., Joseph, col. 4, lines 42-48; and Edmonds, col. 2, lines 43-51 and col. 3, lines 1-8). As acknowledged by the Examiner, the voids taught by Joseph are not porosity due to the fused deposition modeling technique. Furthermore, as mentioned above, neither Joseph nor Edmonds disclose any cracks, scratches, or voids that collectively extend or otherwise cover substantially the entire object surface. Indeed, prior to the current invention, it was unclear to Appellants whether a vapor smoothing process would be effective to substantially eliminate the surface porosity that extends substantially across the entire object surface. Thus, Applicants assert that substantial elimination of the surface porosity is an unpredictable and unexpected result of the claimed combination.

II. Long-Felt Need for Smoothing Objects Built with the Fused Deposition Modeling Technique

As also discussed in Appellants' Appeal Brief, layered manufacturing rapid prototyping techniques have been around for over 20 years. In fact, the assignee of the present application filed a patent application in October, 1989 directed to the fused deposition modeling technique (issued as U.S. Patent No. 5,121,329), and the patent application for Batchelder, U.S. Patent No. 5,653,925 was filed in September, 1995. Due to their layer-by-layer nature, these layered manufacturing rapid prototyping techniques typically provide three-dimensional objects having surface effects, such as stair-step effects and striation effects, as discussed above.

While these surface effects typically do not affect the strengths of the three-dimensional objects, they do detract aesthetically (present application, page 2, lines 16-22). As such, there has been a long-felt need to eliminate the surface effects of three-dimensional objects built by layered manufacturing rapid prototyping techniques, including objects built by the fused deposition modeling technique. In fact, as discussed in the present application, attempts have been made to smooth the surfaces of such objects by manually trimming, machining, grinding, or buffing with cloths, sand paper, or solution-born abrasives (present application, page 3, line 6-17). However, such removal techniques also remove portions of the object surface, which can damage the fine features of the object, and are labor intensive.

Additionally, as discussed above, Leyden, which was filed in 1992, also discusses the need for smoothing object surfaces. However, the stereolithographic processes of Leyden are not suitable for the claimed vapor smoothing process of the present application (Leyden, col. 6, lines 56-68; col. 9, lines 34-39; and col. 11, lines 35-44). As such, the Leyden processes require a smoothing process, such as applying and curing an additional amount of the curable resin to fill in the surface discontinuities, to provide smooth surfaces (Leyden, col. 7, lines 1-15). This process is not readily applicable for smoothing surfaces of objects built with the fused deposition modeling technique.

Despite the extended time period in which the fused deposition modeling technique has existed, Appellants assert that they are the first to substantially eliminate surface effect(s) in objects built with the fused deposition modeling technique with the use of the claimed vapor smoothing process. If the claimed process were otherwise obvious to one skilled in the art, as the Examiner erroneously contends, then Appellants question why the claimed process did not

show up in the field prior to Appellants' development, despite the long-felt need for such low labor-intensive techniques. Accordingly, in addition to the reasons discussed above, Appellants assert that the processes recited in claims 1, 21, and 43 of the present application present a solution to a long-felt need for efficiently smoothing the surfaces of objects built with the fused deposition modeling technique.

The Examiner's Answer stated that Leyden and the background section of the present application disclose the techniques for surface smoothing objects built have been previously satisfied, such as by manually trimming, sanding, and the like (Examiner's Answer, pages 13-14). However, as indicated above, the need is not merely for a technique to obtain a smooth surface, but for a technique that obtains a smooth surface in a manner that reduces the manual labor required by the prior art techniques, such as manually trimming, sanding, and the like. Furthermore, the need is also for a technique that protects fine features of the object, which may otherwise be damaged with the labor-intensive techniques.

III. Long-Felt Need for Substantially Eliminating Surface Porosity In Objects Built with the Fused Deposition Modeling Technique

As also discussed in Appellants' Appeal Brief, objects built with the fused deposition modeling technique are porous due to the build technique (Zinniel Decl., ¶ 10). The pores are created to provide a cushion in the build parameters when depositing materials to maintain dimensional accuracy of the objects (Zinniel Decl., ¶ 10). This is discussed in Batchelder, U.S. Patent No. 5,653,925, filed in September, 1995 (Zinniel Decl., ¶ 10).

It is known to those skilled in the art that objects built with the fused deposition modeling technique are suitable for use as real, usable parts due to the strengths of the thermoplastic modeling materials. However, such objects are also porous, which allows fluids to pass through the walls of the objects, thereby potentially reducing the functionality of the objects to retain gases and liquids. This is demonstrated in the tests discussed in the Zinniel Declaration. For example, such objects may be less desirable for use as liquid vessels (e.g., a coffee cup) due to the porosity.

As such, there has been a long-felt need to substantially eliminate the porosity of three-dimensional objects built by the fused deposition modeling technique, which may create watertight objects that can withstand pressure buildup (Zinniel Decl. ¶ 11, and Medina Decl. ¶ 2).

Yet, despite this long-felt need, Appellants assert that they are first to substantially eliminate the porosity in the objects at the object surfaces with the use of the claimed vapor smoothing process. If the claimed process were otherwise obvious to one skilled in the art, as the Examiner erroneously contends, then Appellants question why the claimed process did not show up in the field prior to Appellants' development, despite the long-felt need for sealed-walls objects.

The Examiner's Answer stated that there is no objective evidence that an art recognized problem existed for a long period of time without a solution (Examiner's Answer, pages 15-16). In response, Appellants respectfully assert that the Medina Declaration indicates that the porosity issue, and the need for water-tight three-dimensional parts, was known to those skilled in the art (Medina Decl. ¶ 2). Furthermore, the assignee of the present application has been building and publicly providing three-dimensional objects having porosity for many years (e.g., since the filing date of Batchelder, U.S. Patent No. 5,653,925 of September, 1995).

Furthermore, it is well known to those skilled in the art that three-dimensional objects built using the fused deposition modeling technique are used in a variety of applications, including applications in which water-tight parts are desired (e.g., for piping and containers). This is objective evidence known to those skilled in the art that the porosity and the need for water-tight objects has been present for many years prior to Appellants' invention. However, as mentioned above, Appellants assert that they are first to substantially eliminate the porosity in the objects at the object surfaces with the use of the claimed vapor smoothing process.

Moreover, Appellants assert that the plastic articles that are smoothed pursuant to Joseph and Edmonds are typically built from an injection molding or similar technique, and do not exhibit such porosity issues. Thus, the plastic articles do not exhibit any reduction in surface porosity. Joseph and Edmonds do not recognize the issue that is presented by objects built with the fused deposition modeling technique. Accordingly, this combination of exposing the object to solvent vapors/reflowing the softened modeling material with the use of an object built with a fused deposition modeling technique provides substantial porosity elimination characteristics that are not present in, nor recognized by, the teachings of the cited references.

The Examiner's Answer also stated that "neither Joseph nor Edmonds teach [that] the objects are typically built from an injection molding or similar technique." (Examiner's Answer, page 16). However, it is well known to those skilled in the art that the articles disclosed in Joseph and Edmonds (e.g., telephone casings) are fabricated with common injection molding

techniques. Moreover, it is clear that neither Joseph nor Edmonds support any contention that the disclosed objects (e.g., telephone casings) have porosity due to the fused deposition modeling technique. This is simply not recognized by either Joseph and Edmonds.

IV. Summary

For the reasons discussed above and recited in Appellants' Appeal Brief, the cited references, taken alone or in combination, do not teach or render obvious the elements of claims 1, 21, and 43. As such, claims 1, 21, and 43 are not obvious over the specification of the present application (pages 1-4 and 8) as exemplified in part by Crump in view of Joseph, Edmonds, and/or Batchelder, and are allowable. Additionally, dependent claims 3, 8, 10, 11, 18, 19, 22, 27, 28, 33, 45, and 47-49, which depend from claims 1, 21, and 43 are also not obvious over the specification of the present application (pages 1-4 and 8) as exemplified in part by Crump in view of Joseph and/or Edmonds, and are separately allowable.

V. Claims 4, 5, 18, 20, 23, 46, and 48

Claims 4, 5, 18, 20, 23, 46, and 48 also stand rejected as being obvious over the specification of the present application (pages 1-4 and 8) as exemplified in part by Crump in view of Joseph or Edmonds, and Batchelder, and further in view of Dahlin, Leyden, and/or Gessner. These rejections were maintained in the Advisory Action. As discussed above, independent claims 1, 21, and 43 are not obvious over the specification of the present application (pages 1-4 and 8) as exemplified in part by Crump in view of Joseph, Edmonds, and/or Batchelder, and are allowable.

The Examiner has also not articulated that Dahlin, Leyden, or Gessner provide any additional teachings to render the elements of claims 1, 21, and 43 obvious. Furthermore, the Examiner's Answer does not provide any further arguments on these points. As such, claims 1, 21, and 43, and dependent claims 4, 5, 18, 20, 23, 46, and 48, which depend from claims 1, 21, and 43, are not obvious over the specification of the present application (pages 1-4 and 8) as exemplified in part by Crump in view of Joseph/Edmonds, Batchelder, Dahlin, Leyden, and/or Gessner.

CONCLUSION

With this response, Applicants and Appellants submit an earnest effort to address all issues raised in the Final Office Action of February 3, 2010, the Advisory Action of May 24, 2010, and the Examiner's Answer of October 25, 2010. For all the reasons advanced above, Appellants respectfully submit that claims 1, 3-5, 8, 10, 11, 18, 20-23, 27, 28, 33, 43, and 45-49 of this application are in condition for allowance, and that such action is earnestly solicited.

Respectfully submitted,

WESTMAN, CHAMPLIN & KELLY, P.A.

By: /Brian R. Morrison/
Brian R. Morrison, Reg. No. 58,455
900 Second Avenue South, Suite 1400
Minneapolis, Minnesota 55402-3319
Phone: (612) 334-3222 Fax: (612) 334-3312

CLAIMS APPENDIX

1. (Previously Presented) A method for making a three-dimensional object comprising the steps of:

providing an object built from a polymeric or wax modeling material using a fused deposition modeling technique, wherein the built object has an object surface formed of the modeling material, wherein the object surface has at least one surface effect due to the fused deposition modeling technique, wherein the at least one surface effect extends substantially across an entirety of the object surface, wherein the at least one surface effect is selected from the group consisting of a stair step effect, striation, a roughness due to errors in building the object, and a combination thereof, and wherein the object exhibits porosity due to the fused deposition modeling technique;

exposing the object to vapors of a solvent that transiently softens the modeling material at the object surface; and

reflowing the softened modeling material to substantially eliminate the at least one surface effect and to substantially eliminate the porosity of the object at the object surface.

2. (Canceled)

3. (Previously Presented) The method of claim 1, where the modeling material comprises a thermoplastic resin.

4. (Original) The method of claim 3, wherein the thermoplastic resin comprises at least about 50 weight percent of an amorphous thermoplastic selected from the group consisting of ABS, polycarbonate, polyphenylsulfone, polysulfone, polystyrene, polyphenylene ether, amorphous polyamides, acrylics, poly(2-ethyl-2-oxazoline), and blends thereof.

5. (Original) The method of claim 4, wherein the solvent is selected from the group consisting of methylene chloride, an n-Propyl bromide solution, perchloroethylene, trichloroethylene, and a hydrofluorocarbon fluid.

6-7. (Canceled)

8. (Previously Presented) The method of claim 1, and further comprising the step of:
selecting a length of time during which the object is to be exposed to the solvent vapors as a function of concentration of the solvent vapors, prior to the exposing step.

9. (Canceled)

10. (Previously Presented) The method of claim 1, and further comprising the step of:
masking selected portions of the object surface with a substance that will inhibit smoothing of the selected portions, prior to the step of exposing the object to the vapors of the solvent.

11. (Previously Presented) The method of claim 1, and further comprising building the object using the fused deposition modeling technique.

12-17. (Canceled)

18. (Previously Presented) The method of claim 1, and further comprising the step of:
suspending the object in a vessel containing the vapors of the solvent in a manner that substantially allows the entirety of the object surface to be exposed to the vapors of the solvent.

19. (Canceled)

20. (Previously Presented) The method of claim 1, and further comprising the steps of:
- providing an initial object representation in a digital format, the initial object representation having a surface geometry; and
 - modifying the initial object representation to pre-distort certain features of the surface geometry, producing a modified object representation;
 - wherein the object built in the building step has a geometry defined according to the modified object representation; and
 - wherein the desired geometry attained following the exposing step approximately matches that of the initial object representation.
21. (Previously Presented) A method for making a three-dimensional object comprising the steps of:
- providing an object built from a plurality of layers with a modeling material using a fused deposition modeling technique, wherein the object has an object surface, and wherein the plurality of layers create at least one surface effect extending substantially across an entirety of the object surface, the at least one surface effect being selected from the group consisting of a stair step effect, striation, a roughness due to errors in building the object, and a combination thereof, and wherein the object exhibits porosity due to the fused deposition modeling technique;
 - exposing the object to vapors of a solvent that transiently softens the modeling material at the object surface; and
 - reflowing the softened modeling material to substantially eliminate the at least one surface effect substantially across the entirety of the object surface and to substantially eliminate the porosity of the object at the object surface.
22. (Previously Presented) The method of claim 21, where the modeling material comprises a thermoplastic resin.

23. (Original) The method of claim 22, wherein the thermoplastic resin comprises at least about 50 weight percent of an amorphous thermoplastic selected from the group consisting of ABS, polycarbonate, polyphenylsulfone, polysulfone, polystyrene, polyphenylene ether, amorphous polyamide, methyl methacrylate, poly(2-ethyl-2-oxazoline), and blends thereof.

24-26. (Canceled)

27. (Original) The method of claim 21, and further comprising the step of:
masking selected portions of the object surface with a substance that will inhibit
smoothing of the selected portions, prior to the step of reflowing the
surface.

28. (Previously Presented) The method of claim 27, wherein the masking substance is applied using an automatic process selected from the group consisting of a jetting process and a fused deposition modeling process.

29-32. (Canceled)

33. (Previously Presented) The method of claim 21, wherein the solvent is selected from the group consisting of methylene chloride, an n-Propyl bromide solution, perchloroethylene, trichloroethylene, a hydrofluorocarbon fluid, and combinations thereof.

34-42. (Canceled)

43. (Previously Presented) A method for treating a three-dimensional object built with a modeling material using a fused deposition modeling technique, the method comprising:

providing the three-dimensional object to a vessel configured to contain vapors of a solvent, wherein substantially an entire exterior surface of the three-dimensional object comprises at least one surface effect caused by the fused deposition modeling technique, wherein the at least one surface effect is selected from the group consisting of a stair-step effect created by layering of a plurality of layers of the modeling material, striation created by formation of roads of the modeling material, surface roughness created by errors in the building of the three-dimensional object, and a combination thereof, and wherein the object exhibits porosity due to the fused deposition modeling technique;

placing the three-dimensional object in the vessel in a manner that exposes substantially the entire exterior surface of the three-dimensional object to the vapors of the solvent, wherein the vapors of the solvent transiently soften the modeling material across the entire exposed exterior surface of the three-dimensional object; and

reflowing the softened modeling material to substantially eliminate the at least one surface effect across the entire exposed exterior surface and to substantially eliminate the porosity of the object at the object surface.

44. (Canceled)

45. (Previously Presented) The method of claim 43, where the modeling material comprises a thermoplastic resin.

46. (Previously Presented) The method of claim 45, wherein the thermoplastic resin is selected from the group consisting of ABS, polycarbonate, polyphenylsulfone, polysulfone, polystyrene, polyphenylene ether, amorphous polyamides, acrylics, poly(2-ethyl-2-oxazoline), and blends thereof.

47. (Previously Presented) The method of claim 43, wherein the solvent is selected from the group consisting of methylene chloride, an n-Propyl bromide solution, perchloroethylene, trichloroethylene, a hydrofluorocarbon fluid, and combinations thereof.

48. (Previously Presented) The method of claim 43, wherein placing the three-dimensional object in the vessel comprises suspending the three-dimensional object in the vessel.

49. (Previously Presented) The method of claim 43, and further comprising masking selected portions of the exterior surface with a substance that will inhibit smoothing of the selected portions.

EVIDENCE APPENDIX

1. Enclosed with this Reply Brief is a copy of the Declaration of Fransisco Medina under C.F.R. § 1.132, filed by Applicants on March 27, 2009. The Examiner entered the Medina Declaration in the June 19, 2009 Office Action, as indicated in the last paragraph on page 10 of the June 19, 2009 Office Action.
2. Enclosed with this Reply Brief is a copy of the Declaration of Robert L. Zinniel under C.F.R. § 1.132, filed by Applicants on November 18, 2009. The Examiner entered the Zinniel Declaration in the February 3, 2010 Final Office Action, as indicated in the first sentence on page 9 of the February 3, 2010 Final Office Action.

RELATED PROCEEDINGS APPENDIX

None.